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MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

V SEMESTER B.TECH (ELECTRICAL & ELECTRONICS ENGINEERING)

MAKEUP EXAMINATIONS, DECEMBER 2018

SUBJECT: DIGITAL SIGNAL PROCESSING [ELE 3102]

REVISED CREDIT SYSTEM

Time: 3 Hours **Date:23 DECEMBER 2018** **Max. Marks: 50**

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitably assumed.
- Quick reference table may be supplied

1A. A analog signal $x_a(t)$ is composed of a weighted sum of 3 sinusoidal signals is given by

$x_a(t) = 4\cos 90\pi t + 7\sin 150\pi t + 3\cos 450\pi t$

(i) Determine the discrete time signal $x[n]$ obtained after sampling at the rate of 300 Hz.

(ii) What condition must be satisfied by sampling rate to ensure $y(t) = x_a(t)$?

(iii) Find the folding frequency.

(iv) Obtain the reconstructed signal $y(t)$? ***(04)***

1B. Obtain a 4- point DFT of the sequence,

$x[n] = \delta[n+2] + 2\delta[n] - \delta[n-1]$ ***(03)***

1C. For a given real sequence $x[n] = \delta[n+2] + 2\delta[n-1] - \delta[n-2]$

Find the 6 point circular convolution of x[n] with h[n].

Given $h[n] = \delta[n] + 2\delta[n-1] + 3\delta[n-2]$ ***(03)***

2A. Consider a finite sequence $x[n] = \delta[n-1] + 2\delta[n-2] + 3\delta[n-3] + 4\delta[n-4]$

(i) Find y[n] if the 6 point DFT, $Y(k) = W_6^{-2k}\, X(k)$

(ii) Find the 6 point sequence, z[n] if Z(k)= Imag{ X(k)} ***(03)***

2B. Determine the output y[n] of a filter whose impulse response is

$h[n] = 2\delta[n] - \delta[n-1] + 2\delta[n-2]$

and input signal is $x[n] = (-2)^n \{u[n] - u[n-8]\}$ using overlap – save method.

Take sub frame length of 4. ***(03)***

2C. Synthesize the lattice ladder network for the system described by the difference equation $y[n]=\frac{1}{2}y[n-1]+\frac{1}{4}y[n-2]+x[n]+x[n-1]$. Comment on the stability of the system and also draw the lattice ladder network. ***(04)***

3A. Briefly explain pole-zero placement method for high-pass and notch IIR filter design ***(02)***

3B. Find the eight point DFT of $x[n]=2\delta[n+3]-2\delta[n+1]-3\delta[n-2]+4\delta[n-3]$, using Radix-2 DIF FFT algorithm. Draw the DIF FFT butterfly diagram and show the calculation for each stage. ***(04)***

3C. Determine a_1, a_2, c_1 and c_0 in terms of b_1 and b_2 so that the two systems shown in Fig. Q 3C are equivalent. ***(04)***

4A. Design a 7-tap Band-Pass linear phase FIR digital filter using Hamming window for the following desired frequency response. Also draw the linear phase realization of the filter.

$$\left|H_d\left(e^{j\omega}\right)\right|=\begin{cases}1; & for\ 0.4\pi\le|\omega|\le 0.75\pi\\ 0; & otherwise\end{cases}$$

(05)

4B. Design a linear phase low-pass FIR digital filter using frequency sampling method with cutoff frequency of $\frac{\pi}{2}$ radian/sample by taking 9 samples of ideal frequency response. Also find the transfer function of the filter. ***(05)***

5A. Establish a relation between analog and digital frequency with reference to bilinear transformation and also show that for every point in z-plane there is exact corresponding point in s-plane and vice-versa ***(04)***

5B. Design a digital IIR low-pass Butterworth filter using Bilinear transformation (BLT) technique to satisfy the following specifications:

Take T=1 second

$$0.84\le\left|H\left(e^{j\omega}\right)\right|\le 1;\quad for\ 0\le\omega\le\frac{\pi}{3}$$

$$\left|H\left(e^{j\omega}\right)\right|\le 0.31;\quad for\ 0.75\pi\le\omega\le\pi$$

(06)

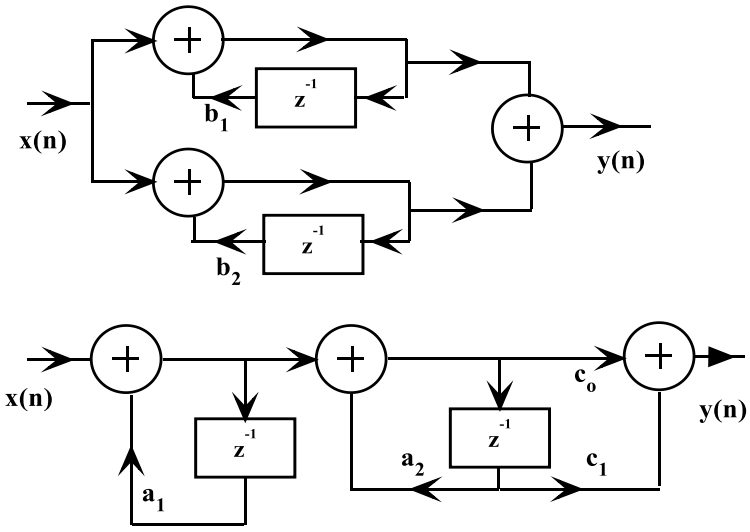

Fig. Q 3C